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IMPROVEMENT OF STARCH GELATINIZATION AND AMINO ACIDS PROFILE OF GROWOL WITH ADDITION OF GERMINATED MUNGBEAN (Vigna Radiata)

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ABSTRACT
Growol is a food product from cassava which has the potential to be developed into composite flour as a substitute for wheat flour. But it needs an effort to improve the protein quality of cassava growol. Germination of beans had been known to reduce bean flavor, reduce anti-nutritional compounds and improve protein quality. The aim of this study was to determine the characteristics of amino acids and starch gelatinization of composite flour from growol flour with the addition of mung bean sprouts flour. The study was carried out with a completely randomized design with single factor namely the type of flour, that are growol flour from cassava, composite flour, and wheat flour. Composite flour was made by mixing growol flour with mung bean sprout flour in a ratio of 3 : 1. The flour product is analyzed water content, gelatinization properties, and amino acid composition. The results showed that there were differences in the characteristics of growol flour with composite flour, except peak time, gelatinization temperature, and water content. Mixing of mung bean sprout flour on growol flour resulted the gelatinization profile of composite flour was closer to wheat flour, so that composite flour can be used as a substitute for wheat flour. The protein quality of composite flour is better than growol flour which is indicated by an increase in levels of amino acids, especially esseansial amino acids. Increasing of arginine which very high, indicated that the composite flour had the potential as a functional food.

Keywords: composite flour, gelatinization, amino acid, cassava, mung bean

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INTRODUCTION

Flour made from wheat (wheat flour) has now become the main requirement of the people of Indonesia, because processed flour products include bread and noodles are very popular even though wheat is obtained through imports. Indonesia is the world's largest wheat importer and in 2014 there were 7 million tons with an increase of around 1 million tons every year to meet the wheat flour industry, mostly for the production of 55% noodles, 22% white bread and 18% biscuits (Anonim, 2015). Republic of Indonesia Presidential Regulation No. 22 of 2009 stipulates a policy to accelerate the diversification of food consumption based on local resources. The policy is in line with the strategic plan of the Ministry of Agriculture, among others, to support increased consumption of tubers and beans by prioritizing local production, so that consumption of grain (wheat, rice) is expected to decrease by around 1.5% per year (Anonim, 2010). Increased consumption of flour in Indonesia is suspected to be the cause of an increase in diabetics. Indonesia is ranked 5 in the world for diabetics (Shashank and Aravind, 2017). Processed wheat flour products have a high glycemic index (IG) (for example white bread which is often used as IG testing standards with IG values = 100). IG white bread is higher than other staple foods, such as rice (white rice) that has IG value = 83 (Jenkins et al., 1984 in Burtis et al., 1988). Therefore, it is necessary to examine the potential of local food based on tubers to be developed as a substitute for wheat flour with low GI.

Growol is a traditional Kulonprogo food that is made through the process of fermented cassava spontaneously by immersion for 3-5 days. Growol flour has been used as a raw material for analog rice (Kanetro et al., 2017). The process of growingol flour is almost the same as mocaf flour made with controlled fermentation. Mocaf flour can replace wheat flour in bread making (Rizah and Anggita, 2010), but it cannot replace 100% wheat flour because wheat flour contains gluten protein which is not owned by cassava.

Germination of beans is expected to increase the ability of composite flour to prevent diabetes. Pathak (2005) has found that soy flour added 24 hours can control blood sugar and is more effective than OHG. The ability of anti-diabetic properties of soybean sprout flour is due to the synthesis of phosphatydylinositol 3 kinase during germination which is an important component of receptors (Pathak, 2005). Soybean protein sprouts also show a role as insulin-like protein (Pathak and Martirosyan, 2011). Phaseolus vulgaris germination is known to produce bioactive peptides with the ability to inhibit DPP-IV thereby increasing insulin release from pancreatic cells (Rocha et al., 2015). IG brown rice sprouts are lower than seeds (Cornejo et al., 2015).

Another benefit of adding nuts to cassava growol flour is preventing protein deficiency, especially children (Stephenson et al., 2010), because the protein content of cassava is very low, which is around 1% (Stupak et al., 2006). In addition, it strengthens the potential of growol fibers as functional foods, because cowpea and soybean proteins have a high arginine-lysine ratio which is hypocholesterolemic (Kanetro and Dewi, 2013) and based on in vivo testing of cowpea sprouts protein can reduce cholesterol / hypocholesterolemia (Kanetro, 2015a) and reduce blood sugar / hypoglycemic (Kanetro, 2015b). Arginine amino acids are amino acids that are hypocholesterol (Damasceno et al., 2000). Soybean sprouts are known to contain amino acids that stimulate the high secretion of insulin between other Arginine and Leucine (Kanetro, 2018) and have been tested in vitro to increase insulin (Kanetro et al., 2008). The use of nuts will also reduce the growol flour glycemic index (IG) which has high GI. It has been proven in a previous study that showed that analog rice IG from the development of the project (growol dry) with the addition of beans was in the low category, which was lower than 55 (Kanetro et al., 2017).

The search for various other foodstuffs as a substitute for flour continues to be done to reduce flour consumption, among others, by making composite flour. Composite flour is a

mixture of various flour, starch and various ingredients to replace part or all of flour in bakery and pastry products (Noorfarahzilah et al., 2014). Tharise et al (2014) have made composite flour from a mixture of cassava, rice, soybeans, and gum which have physicochemical, functional and gelatinization characteristics that are comparable to wheat flour. Research on composite flour from a mixture of cassava treated with fermentation such as in making growol and legumes which were germinated to produce flour characteristics similar to wheat flour has never been done. This study aims to determine the characteristics of composite starch and amino acid gelatinization from growol flour with the addition of green bean sprout flour.

METHODS

Material

The materials used in this study growol flour made from white cassava (Manihot esculenta) of the type obtained in the Cassava Market, Karangkajen and Gamping Market, Yogyakarta with the characteristics of red inner skin. Mungbean was obtained at UD Hasil Indah, Yogyakarta. Corn starch is obtained at the Intisari Shop, Yogyakarta. The pure culture of *Lactobacillus bulgaricus* was obtained from the Microbiology Laboratory of the UGM Center for Nutrition Studies Yogyakarta. The PA (Merck) chemicals for the main chemical analysis include HCl, NaOH, H2 SO4, 18 standard amino acids OPA (orthophethaldialdehyde), methanol, acetate buffer, borate buffer, osalic acid, Pb-acetate (Plumbous acetate), distilled water and aquabides.

Experimental design

This research was carried out with a completely randomized design of single factors with the treatment of type of flour namely growol flour and composite flour. legume sprouts, such as bean sprouts, dough, stump, and soybean seeds as a control. The study was conducted with 2 replications of the experiment and the data obtained were analyzed ANOVA statistics followed by a real difference DMRT test (Gomez and Gomez, 1995) using the SPSS 14.0 for windows evaluation version computer program at 95% confidence level.

The process of making cassava growol flour

The process of making growol flour refers to the research of Kanetro and Luwihana (2018) with modifications, namely by adding starter cultures of Lactobacillus bulgarigus at the beginning of soaking cassava in water for 3 days. Furthermore, the filtering process uses filter cloth, followed by a squeeze and pressing process using a hydrolic press to reduce water content. The pulp produced by pressing is called growol. The next process is drying using a cabinet dryer at a temperature of 50-60^{o} C for 2.5-3 hours for every 1 kg of material to a moisture content of about 10%, grinding and sieving 60 mesh to obtain growol flour (Kanetro et al., 2018).

The process of making mungbean sprout flour

Making green bean sprout flour based on Kanetro et al. (2018) showed that the best green beans were obtained at 12-hour germination. Green bean sprouts are dried, milled and sifted 60 mesh so that the green bean sprout flour is obtained.

The process of making composite flour

Based on the research of Kanetro et al (2018) the results showed that the ratio of growol flour: the best mung bean sprout flour was 3: 1 with the addition of 3% corn starch giving the sensory properties of flour and dough that approached wheat flour. For this reason, composite flour in this study was prepared by mixing growol flour as much as 700 g, green bean sprout flour 300 g. corn starch / cornstarch as much as 3% of the mixed amount (30g) using a mixing machine for 1 minute. The composite flour is packaged and ready for analysis.

Analysis

The analysis carried out in this study included analysis of the moisture content of the heating method using an oven (AOAC, 1995), gelatinization profile using RVA (Rapid Visco Analyzer) Tecmaster type Parten brand, SEM Hitachi brand type TM 3000 carried out in Chemical Laboratory F TP UGM Yogyakarta, and amino acid profiles using HPLC (High Performance Liquid Chromatography) by the OPA method (Antoine et al., 1999) which was modified according to Kanetro and Setyowati's research (2013) carried out at the UGM LPPT Laboratory Yogyakarta.

RESULTS AND DISCUSSION

Gelatinization profile

The results of testing the gelatinization profile showing the characteristics of amylography paste with viscosity parameters, the highest viscosity time reached, and the gelatinization temperature are presented in Table 1. The characteristics of growol flour show very significant differences with wheat flour. The addition of green bean sprout flour to growol flour in composite flour resulted in lower differences in the characteristics of composite flour with flour. Even the peak viscosity and gelatinization temperature between composite flour and wheat flour were not significantly different. Peak viscosity or peak viscosity describes the fragility of an expanding starch granule, which is when it first expands to rupture because of the process of stirring peak viscosity influenced by various factors including amylose content, protein, fat and granule size (Deetae et al., 2008) Mung beans are a type of beans that contain higher starch levels than other types of beans, and contain high protein with low fat content (Kanetro, 2018). This is likely to cause an amylographic characteristic improvement in composite flour so that it approaches the flour compared to cassava growol flour

Table 1. Gelatinization profile of growol flour, composite flour and wheat flour

No	Gelatinization characteristics	Growol flour	Composite flour	Wheat flour
1	Peak viscosity (cp)	3707,00a	2509,00b	2493,00b
2	Hold viscostity (cp)	3318,00a	2097,00b	1779,00c
3	Breakdown viscosity (cp)	389,00c	412,00b	714,00a
4	Final Viscosity (cp)	5219,00a	3164,00b	2716,00c
5	Setback viscosity(cp)	1901,00a	1067,00b	937,00c
6	Peak time (minut)	10,93a	9,80b	10,53ab
7	Gelatinization temperautre °C	86,95a	86,60ab	84,20b
8	Moisture (%bb)	7,57b	7,76b	8,92a

Description: the number followed by the same letter notation in the same row shows no significant difference (P <0.05)

Amino acid profile

The results of testing of amino acid profiles are presented in Table 2 which shows that the amino acid levels of composite flour are higher than growol flour and most are still lower than wheat flour. However, the quality of composite flour protein is almost the same as wheat flour, because the quality of protein is determined by its essential amino acid levels. Some of the essential amino acids in composite flour were not significantly different from wheat flour, namely threonine and lysine. Table 1 also shows that the arginine content of composite flour is higher than wheat flour. This is likely due to the germination process of green beans, as in soy germination can increase arginine (Kanetro, 2018). Arginine is known as an amino acid that is hypoglycemic (Newsholme et al., 2007). Analog rice made from growol flour with green bean flour has also been known to have low GI IG (Kanetro et al., 2017).

Table 2. Amino acid composition of growol flour, composite flour and wheat flour

No	Amino acids composition (%db)	Growol flour	Composite flour	Wheat flour
1	L Aspartic	0,04c	0,65a	0,38b
2	L Glutamic	0,05c	1,14b	3,11a
3	L Histidine	0,01c	0,22b	0,81a
4	L Serine	0,02b	0,03b	0,52a
5	L Treonine	0,02b	0,24a	0,22a
6	L Glycine	0,02c	0,20b	0,47a
7	L Arginine	0,02c	1,06a	0,46b
8	L Alanine	0,03b	0,31a	0,27a
9	L Tyrosine	0,01b	0,18a	0,16a
10	L Methionine	0,01c	0,07b	0,14a
11	L Valin	0,02c	0,30b	0,43a
12	L Phnylalanine	0,02c	0,33b	0,66a
13	L Isoleucine	0,02c	0,23b	0,41a
14	L Leucine	0,03c	0,30b	0,97a
15	L Lycine	0,04b	0,69a	0,66a

Description: a number followed by the same letter notation in the same row shows no significant difference (P <0.05)

The potential of soy protein as a functional food is related to the composition of amino acids, specifically the arginine content, then it is known that the ratio of arginine / lysine plays an important role in controlling cholesterol levels (Damasceno et al., 2000). The higher the ratio of arginine lysine, the more the protein is hypocholesterol. In Table 2, it is known that the arginine ratio of lysine composite flour (1.5) is 2 times higher than wheat flour (0.7), so that composite flour has the potential to be hypocholesterol. Legume protein is known to have a high lysine arginine ratio (Kanetro and Dewi, 2013). This indicates that composite flour has advantages over wheat flour because it has more potential to be used as functional food to prevent degenerative diseases especially diabetes and atherosclerosis due to hypercholesterolemia.

CONCLUSION

Based on this study it can be concluded that mixing green bean sprout flour in growol flour results in its characteristics getting closer to wheat flour, so that composite flour can be used as a substitute for wheat flour. The quality of composite flour protein is better than growol flour which is indicated by an increase in the levels of essential amino acids especially threonine and lysine which are not significantly different from wheat flour. A high increase in arginine indicates that composite flour has the potential as functional food.

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